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TERRESTRIAL MOLLUSCA OF QUEENSLAND: THE FAMILY VERONICELLIDAE

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In Queensland there are two species of slugs of the family Veronicellidae, *Laevicaulis alte* and *Vaginulus plebeius*. A general description of their anatomy is given together with the diagnostic features by which they may be identified. The known Queensland distributions are listed. They are economically important as pests of cultivation and as vectors of vertebrate nematode infections.

The only illustrated account which attempts to deal with the terrestrial mollusc fauna of Australia as a whole is the monograph of Cox (1868). Many problems are therefore experienced in attempting identifications. The check list of Iredale (1937–38) provides a guide to the literature but is uncritical at the species level. Iredale's higher taxa have caused considerable difficulties because of a lack of comparative studies with taxa outside Australia. Zilch (1960) appends a list of over 260 of Iredale's generic names which he was unable to include in the text. Solem (1959) has presented valuable conclusions as to the nature of some of Iredale's genera and families. A number of other papers deal with particular groups but much more research is needed before an adequate monograph can be produced. The present paper is a contribution towards this end.

Methods

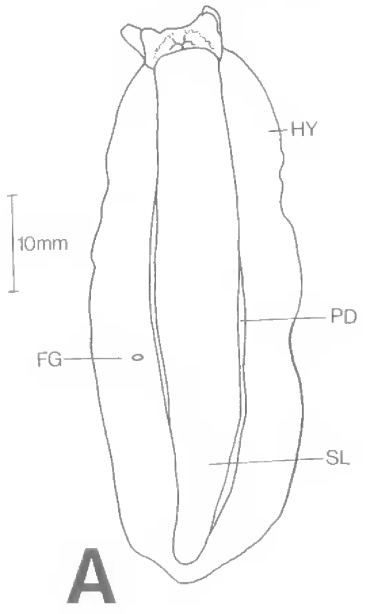
This study is based on material held in the Australian Museum (C series), National Museum of Victoria (F series) and the Queensland Museum (MO series) including recent collections by the author. The reference numbers are the Museum registration numbers applied to each specimen lot. Material is preserved in 70% alcohol or 4% formalin. Dissections were performed with the specimen under water, using fine watchmakers forceps, and drawn with the help of the camera lucida. Jaws and radulae were extracted from the buccal mass in a solution of sodium hydroxide (10%). Names quoted in synonomy refer to Queensland material. Distribution records are grouped according to the half degree 'squares' of latitude and longitude of the Australian Geodetic Datum (Goodrick 1974).

SYSTEMATIC ACCOUNT

Family Veronicellidae

A key to the families of Australian terrestrial slugs is given by Altena and Smith (1975). The species of Veronicellidae are not natives of Australia but were accidentally introduced by man. Members of the family are found throughout the wet tropical regions of the world and some extend to sub-tropical areas. The fullest account of the biology and anatomy of the Veronicellidae is given by Hoffmann (1925). The nomenclature used is not correct, as Baker (1925) pointed out, and I am following the generic assignments used by Forcart (1969). Simroth (1889) described two new species on the basis of Queensland material without making any anatomical studies. Grimpe and Hoffman (1925) examined Simroth's types preserved in the Berlin Museum and placed his names into synonomy.

External Features: The animals are pulmonate slugs without a shell (internal or external) and without a mantle cavity. There is a convex dorsal integument (notum) which extends down over the head. The notum is separated from its ventral extension (hypnotum) by a sharp keel (perinotum). The ventral surface has a central foot sole separated by a pedal groove from the hypnota (Fig. 1A). A pedal gland lies free in the body cavity and opens below the mouth. The head bears two pairs of tentacles, the upper pair (ommatophores)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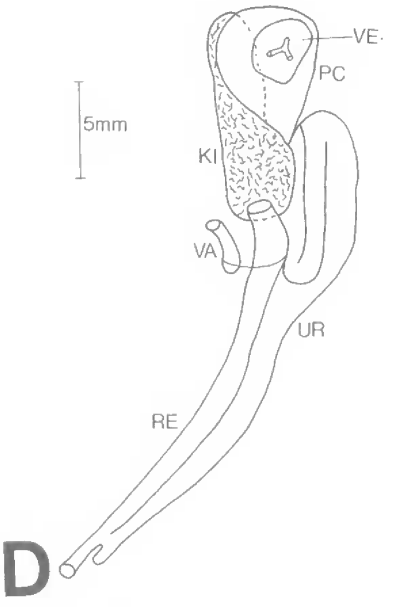
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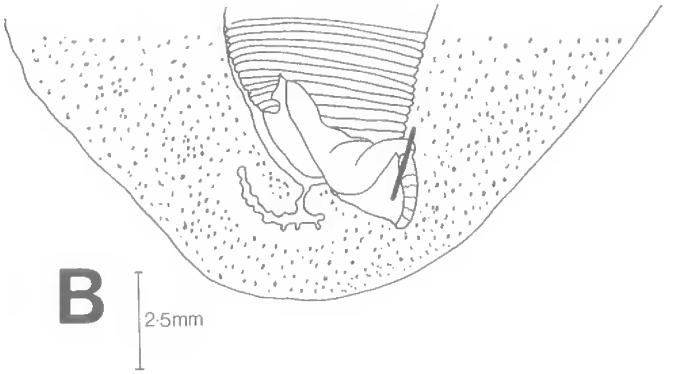
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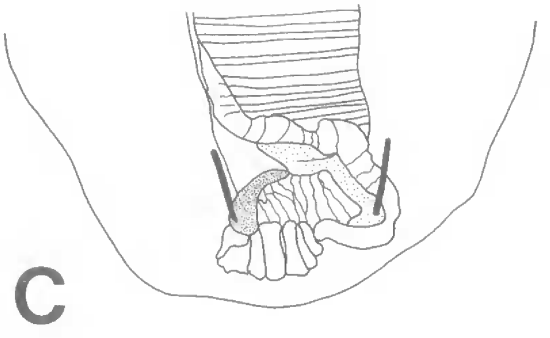
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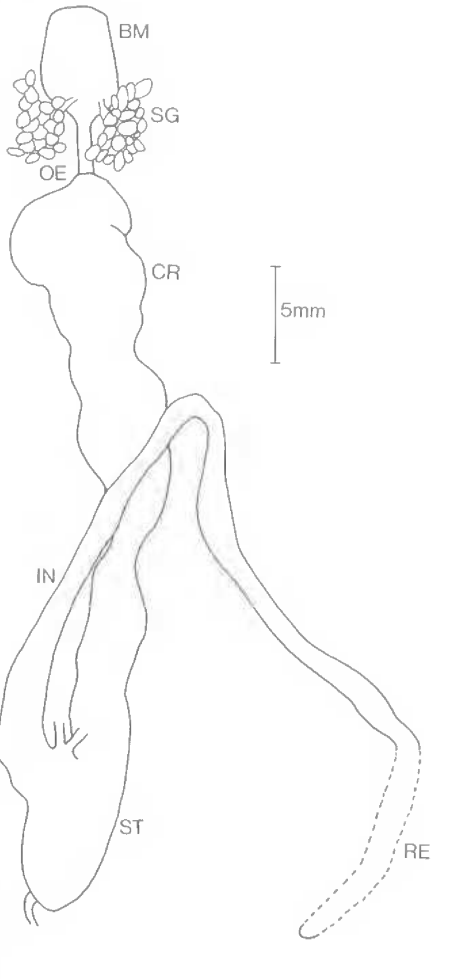
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have eyes on contractile stalks, while the lower pair are bifid with a sensory end bulb (Fig. 2C). The anus opens behind the foot, slightly to the right of the mid-line. The female genital opening is midway on the right hypnotum (Fig. 1A) and the male genital opening is on the right side of the mouth in the pedal groove (Fig. 2C).

Pallial Complex: The pallial complex (Fig. 1D) is situated within the right body wall. The kidney lies along the right side of the pericardium and partly beneath it at the posterior end, extending to where the hindgut enters the body wall. The ureter is S-shaped and contains spongy highly vascularised tissue. The last arm is enlarged and opens into the rectum near the anus.

Digestive System: The buccal mass contains the jaw which is formed of narrow vertical plates and the radula which is composed of unicuspid teeth. In each tooth row of the radula the central tooth is narrow and there are many broader lateral teeth. A pair of salivary glands drain into the buccal cavity (Fig. 1E). A narrow oesophagus leads from the buccal mass to the large crop. From the stomach there are a number of openings to the lobes of the digestive gland. This voluminous gland covers most of the dorsal aspect of the viscerae. The intestine loops forward to enter the body wall on the right side and the rectum receives the ureter before opening at the anus.

Central Nervous System: The paired cerebral ganglia lie above the oesophagus. From these ganglia connectives pass to the paired buccal ganglia on the surface of the buccal mass. Ventrally there are two pedal ganglia and a visceral chain formed by the fusion of five component ganglia into one mass. The point of divergence of the pedal nerves on the floor of the body cavity is variable within the family.

Retractor Muscles: Left and right cephalic, buccal and genital retractors all arise separately on the body wall. This is the situation to be expected in the absence of a shell of any kind.

Reproductive System: The reproductive system (Figs. 2–3) is hermaphrodite but the male portion appears to develop before the female. The hermaphrodite duct leads from the ovotestis to the carrefour or junction with the male and female tracts. Before the junction there may be a small diverticulum, the fertilisation pocket. The female tract consists of a long oviduct which receives the albumen gland near the carrefour and leads to the muscular vagina opening on the right hypnotum. The bursa copulatrix is connected to the vagina by a pedicle and to the male system by the canalis junctor. There may be an accessory bursa attached to the vagina near its opening. The male tract commences with the vas deferens which receives the prostrate gland near the carrefour, gives off the canalis junctor, and enters the body wall associated with the vagina. From here it passes forward to emerge near the penial complex situated to the right of the buccal mass. The penial complex comprises the intromittent penial verge and the penial stimulator with its gland consisting of a bunch of tubules. The verge and stimulator are enclosed in a thin sheath and are supplied with retractor muscles.

Genus **Laevicaulis** Simroth (1913)

Type Species: *Vaginula comorensis* Fischer (1883) by subsequent designation of Pilsbry (1919).

The retracted foot does not extend over the anus. The anal opening is a crescentic slit. The pedal gland is kinked. The pedal nerves diverge from their point of origin. The anterior curve of the intestine lies in front of the digestive gland. The salivary glands are compact. The vagina and hindgut are close together at their point of entry to the body wall. The verge is cylindrical with an annular swelling near the base, and the opening of the vas deferens is terminal. The penial stimulator is short and conical.

Laevicaulis alte (Férussac)

Vaginulus alte Férussac, 1821, p. 14.
Vaginula leydigi Simroth, 1889, pp. 552–6. Odhner, 1917, p. 89.
Meisenheimeria alte; Grimpe and Hoffmann, 1925, pp. 26–31.
Meisenheimeria leydigi; Iredale, 1938, p. 122.

Type Locality: Pondicherry, India.

Diagnostic Features: Distinguished from *V. plebeius* externally by the anal aperture in the form of a cresentic slit and internally by the long cylindrical penis with sub-basal collar and terminal opening of the vas deferens.

Fig. 1: A–B *Laevicaulis alte* (Férussac). A Ventral aspect and B anal orifice (MO5798, Kallangur).
C–E *Vaginulus plebeius* Fischer. C Anal orifice (MO5801, Coorparoo); D pallial complex (MO4127, Indooroopilly); E digestive system (MO5802, New Farm).
BM buccal mass, CR crop, FG female gonopore, HY hypnotum, IN intestine, KI kidney, OE oesophagus, PC pericardium, PD pedal groove, RE rectum, SG salivary gland, SL foot sole, ST stomach, UR ureter, VA vagina, VE ventricle.

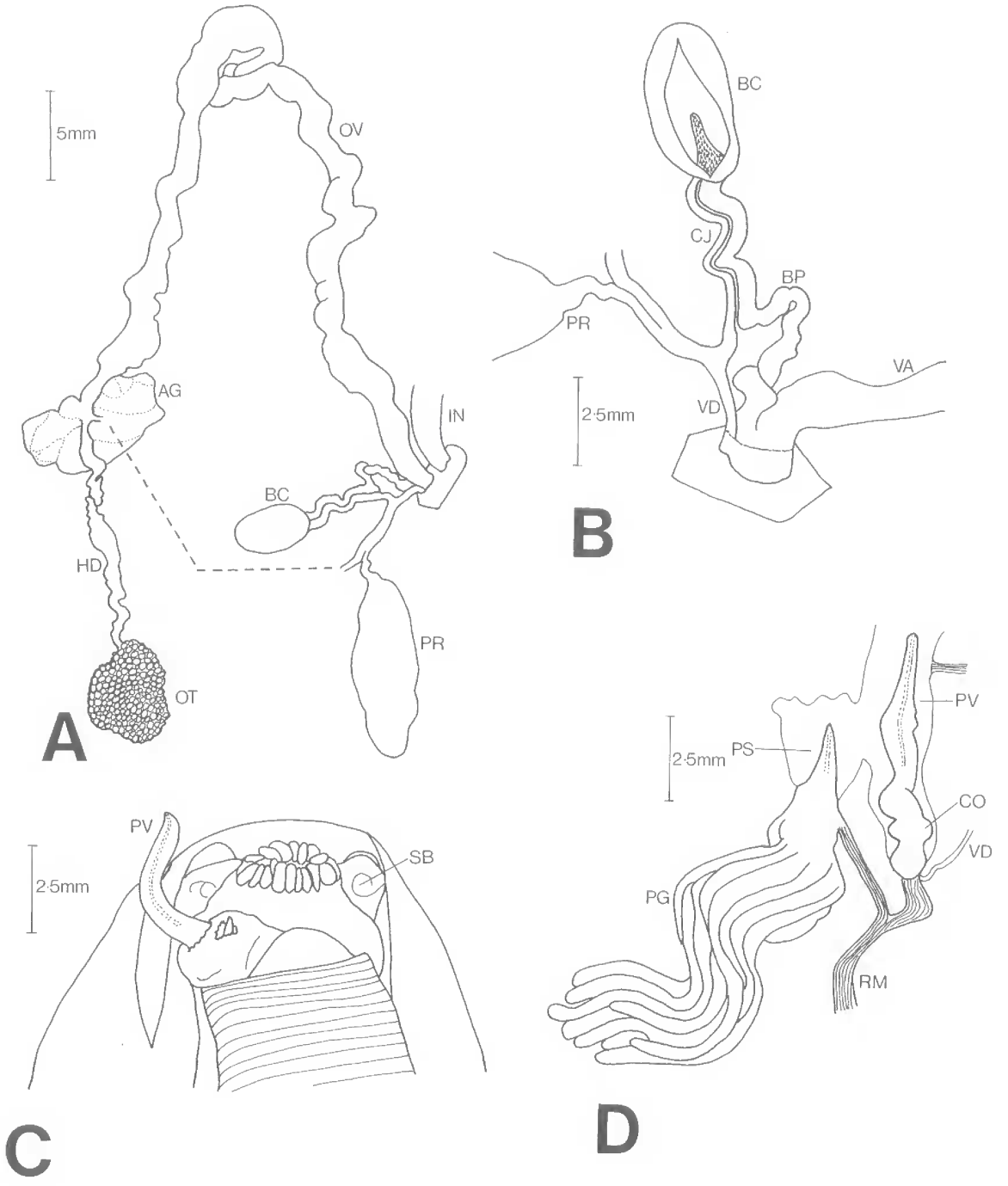

FIG. 2: *Laevicaulis alte* (Férussac). A–B Genitalia (MO4462, Point Lookout); C extruded penial verge and stimulator (MO1615, Brisbane); D penial complex (MO4283, Upper Mt. Gravatt).

AG albumen gland, BC bursa copulatrix, BP bursa pedicle, CJ canalis junctor, CO collar, HD hermaphrodite duct, IN intestine, OT ovotestis, OV oviduct, PG penial gland, PR prostate, PS penial stimulator, PV penial verge, RM retractor muscle, SB sensory bulb, VA vagina, VD vas deferens.

External Features: Length (alcohol material) 62, 50 mm (MO4126), 52 mm (MO4283). The notum is pigmented with dark brown or gray with a lighter yellowish band down the midline. The hypnotum is light in colour. A live animal is illustrated in Plate 12A. The anal aperture is a cresentic slit with a conspicuous pale border (Fig. 1B). The kinked pedal gland is figured by Oberzeller (1970, Fig. 2). The female gonopore is close to the pedal groove. The position of the partially extruded penial verge and stimulator is shown in Fig. 2C from a preserved specimen.

Digestive System: The radula, jaw and digestive tract are figured by Oberzeller (1970, Fig. 3–5). The salivary glands are a whitish compact mass.

Reproductive System: The hermaphrodite duct has a small fertilisation pocket. The prostate is large in the figured specimen (Fig. 2A). The bursa copulatrix has a long pedicle which protrudes into the bursa as a papillate extension. The verge is long and cylindrical with a sub-basal collar and terminal opening of the vas deferens. The penial stimulator is short and conical with a single insertion of the retractor muscle (Fig. 2D). The penial gland has about 18 tubules.

Queensland Distribution: 9°30′S. 144°00′E. Murray Is. (C104230); 15°00′S. 145°00′E. Cooktown (C5731, C104236); 16°30′S. 145°30′E. Yarrabah (Odhner, 1917); 17°00′S. 145°00′E. Atherton (Odhner, 1917); 18°00′S. 146°00′E. Hinchinbrook Is. (C54496); 23°00′S. 150°00′E. Rockhampton (C104231); 23°00′S. 150°30′E. Yeppoon (C104244, F30010); 23°00′S. 151°30′E. Heron Is. (F30009), Nor' West Is. (C104233–4, F13512); 27°00′S. 152°30′E. Kallangur (MO5798); 27°00′S. 153°00′E. Brisbane (C96, MO1615–17, 1762), Fortitude Valley (MO1791), St. Lucia (MO4126); 27°00′S. 153°30′E. Point Lookout (F30013, MO4462); 27°30′S. 153°00′E. Ormiston (MO5799), Salisbury (MO3032), Upper Mt. Gravatt (MO4283); 28°00′S. 152°00′E. Burleigh Heads (F30011).

Range: The species is thought to have originated in southern Asia (possibly India) and to have been widely spread in the Indian Ocean and Pacific regions by commerce. The recorded Queensland distribution is doubtless incomplete and the species is to be expected in suburban and cultivated areas throughout the moist eastern seaboard of the State.

Ecology: The Veronicellidae are nocturnal herbivores or omnivores eating both green plants and decaying organic material. They may cause damage in gardens and horticultural nurseries and may be difficult to control even with the use of slug bait (metaldehyde). Little seems to be known about the life history and general biology of *L. alte*.

Genus **Vaginulus** Férussac (1821)

Type Species: *Vaginulus taunaisii* Férussac (1821) by subsequent designation of Stoliczka (1873).

The retracted foot extends over the anus. The anal opening is protected by a flap on the right. The pedal nerves do not immediately diverge. All intestinal loops are embedded in the digestive gland. The pedicle of the bursa copulatrix is short or absent. The penis is somewhat asymmetrical with the opening of the vas deferens subterminal.

Vaginulus plebeius Fischer

Vaginulus plebeius Fischer, 1868, p. 146.
Vaginula Hedleyi Simroth, 1889, pp. 552–556.
Vaginula hedleyi; Odhner, 1917, p. 89.
Sarasinula plebeja; Grimpe and Hoffmann, 1925, pp. 25–26.
Sarasinula hedleyi; Iredale, 1938, p. 123.

Type Locality: New Caledonia.

Diagnostic Features: Distinguished from *L. alte* externally by the dextral flap covering the anal aperture and internally by the swollen asymmetrical penial verge with subterminal opening of the vas deferens.

External Features: Length (alcohol material) 58, 54 mm (MO5801), 47 mm (MO4127). The notum is pigmented light brown with black points particularly on each side of the midline. The hypnotum is light in colour. A live animal is illustrated in Plate 12B. The anal aperture is covered by a flap on the right side which when lifted reveals a deep wide pit (Fig. 1C). The female gonopore is about half way between the pedal groove and the perinotum. The straight pedal gland is figured by Hoffmann (1925, Fig. 5A).

Digestive System: The radula is figured by Hoffmann (1925, Fig. 8q). The salivary glands are yellowish and in the form of bunches of grapes (Fig. 1E).

Reproductive System: The individual figured (Fig. 3A) appeared sub-adult. There is no fertilisation pocket in the hermaphrodite duct. The prostate is small. The bursa copulatrix has a short pedicle continued into the bursa as an extension without papillae. The verge is asymmetrical with a subterminal opening of the vas deferens. Baker (1931, plate 8, fig. 2) showed how the verge does not

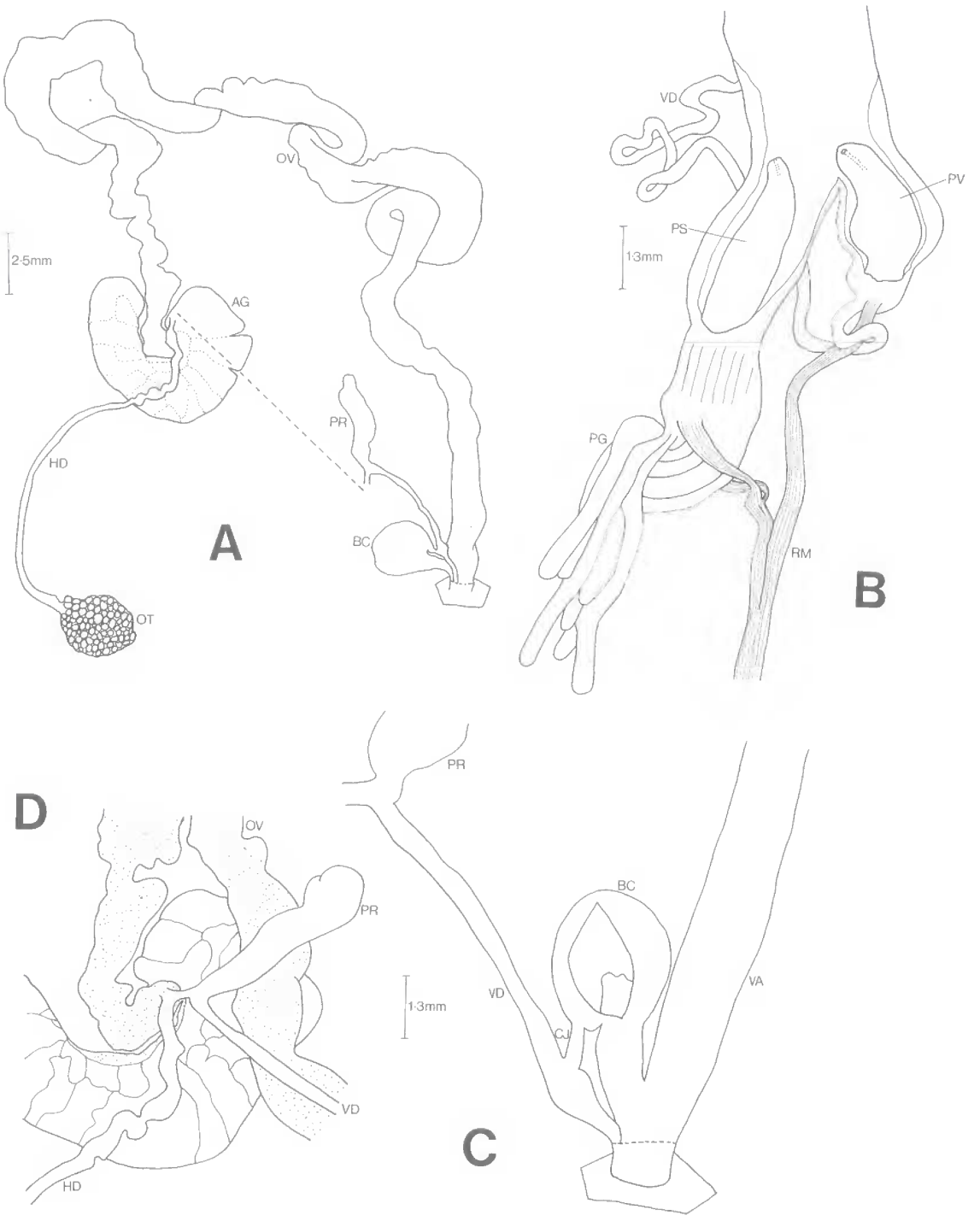

FIG. 3: *Vaginulus plebeius* Fischer. A Genitalia, B penial complex, C region of bursa copulatrix (MO5802, New Farm); D details of carrefour (MO5801, Coorparoo).

AG albumen gland, BC bursa copulatrix, CJ canalis junctor, HD hermaphrodite duct, OT ovotestis, PG penial gland, PR prostate, PS penial stimulator, PV penial verge, RM retractor muscle, VA vagina, VD vas deferens.

have a terminal papilla but has a broad weakly emarginate flap which appears as a papilla in side view. The penial stimulator is long and broad with a double insertion of the retractor muscle (Fig. 3B). The penial gland has about 6–8 tubules.

QUEENSLAND DISTRIBUTION: 13°30′S. 143°00′E. Coen (F30014); 15°00′S. 145°00′E. Cooktown (C104529); 16°30′S. 145°30′E. Cairns (C104243); 17°00′S. 145°00′E. Atherton, Herberton (Odhner, 1917), Tinaroo Dam (F30012); 19°00′S. 146°30′E. Townsville (C104240–1); 20°00′S. 148°30′E. Proserpine R. (C104187); 21°00′S. 149°00′E. Sarina (C104237, juv. only); 23°00′S. 150°00′E. Rockhampton (C104235); 27°00′S. 153°00′E. Brisbane (C95, 104239); Kangaroo Point (MO5805), New Farm (MO5802), Redcliffe (MO5803); 27°30′S. 152°30′E. Chelmer (MO1964), Indooroopilly (MO4127, 5804); 27°30′S. 153°00′E. Coorparoo (MO5801), Ormiston (MO3450); 28°00′S. 148°30′E. St. George (C104238, juv. only).

RANGE: The species is thought to have originated in the tropical American region. It has been widely spread by commerce in the Indian Ocean and Pacific regions. It is to be expected in regions of cultivation along the east Queensland coast.

ECOLOGY: As in the case of *L. alte* this species may become a pest in gardens. *V. plebeius* acts as a secondary host for certain nematode infections of vertebrates and has even been implicated in human disease (Modera and Céspedes, 1973).

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